

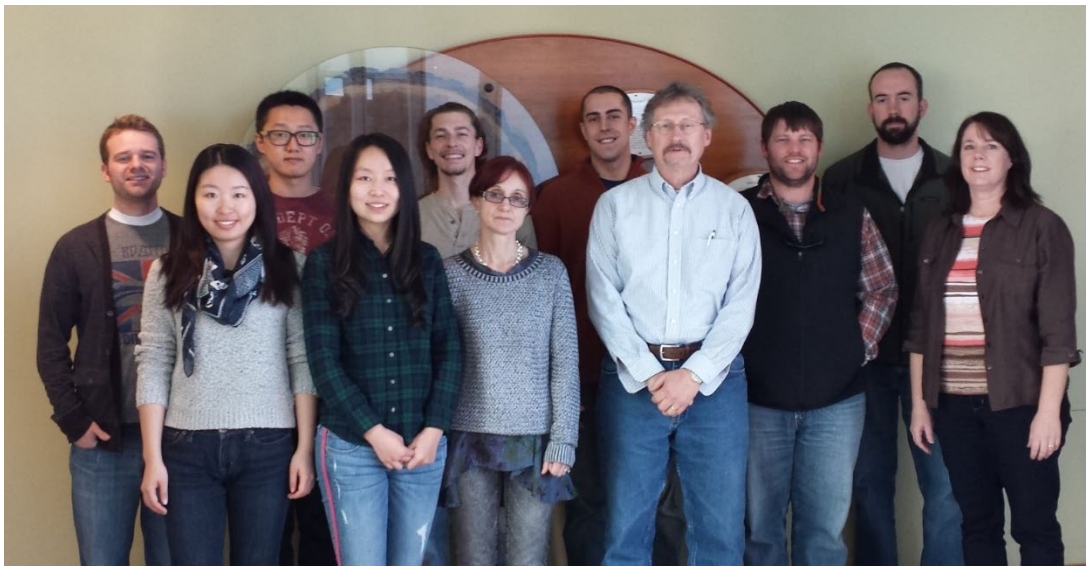
PENNSTATE



College of Agricultural Sciences

L.W. SCHATZ CENTER FOR TREE MOLECULAR GENETICS REPORT FOR 2013-2015

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The Schatz Center Tree Molecular Genetics Personnel, Fall, 2014

l to r: Nathaniel Cannon, Wanyan Wang, Tao Pang, Di Wu, Alex Stanish, Teo Best, Byron Bredeal, John Carlson, Casey Weathers, Jeff Osborne, Nicole Zembower

L.W. SCHATZ CENTER FOR TREE MOLECULAR GENETICS REPORT FOR 2014

The Schatz Center for Tree Molecular Genetics at Penn State continues to be a world leader in research and training in modern tree genetics, with impacts at both national and international scales. The endowed support from Dr. Louis W. Schatz for post-doctoral fellows, visiting scholars, undergraduate research, student field trips, and biennial symposia makes this possible. We have been very busy since the past report, in all the areas supported by Schatz Center funds.

The Schatz Visiting Scholars Fund:

The Schatz Center continues to attract international collaborations through the Schatz Visiting Scholars program. In 2013 and 2014, The Schatz Center hosted 4 international visitors from the Philippines, China, and Indonesia. During their visits, we started research collaborations on the genetics of flowering in teak trees, flowering and fruit production in bananas, and disease resistance in nut trees. In addition we hosted 4 minority undergrad summer research interns from the University of West Alabama, and their mentor who conducted research projects in The Schatz Center. We have also hosted research collaborators from Oregon State University and within Penn State. Recent recipients of the Schatz Visiting Scholars program were:

- Tao Pang, Ph.D. student, Beijing Forestry University, 2014-2015.
- Dr. Nicholas Wheeler, Adjunct Professor, Oregon State University, 2013, 2014
- Dr. Teodora Orendovici Best, Pennsylvania State University, 2014
- Dr Ketia Shumaker, Department of Biology, University of West Alabama, 2013, 2014
- Diky Diningrat, PhD student, Institut Teknologi, Bandung, Indonesia, Jan. to July, 2013.
- Dr. Nanan Martiana, visiting professor, Institut Teknologi, Bandung, Indonesia, 2013.
- Dr. Ma. Genaleen Diaz, Fulbright Scholar from the University of the Philippines, November 1, 2012 to May 5, 2013.



Rebecca Carroll, Chicko Jones, T Best||



Schatz Center, 2013, l to r: Kelvineisha Williams, Di Wu, Wanyan Wang, Odom, Timothy, Teo Best, Nicole Zembower, Nanan Widiyanto, Donghwan Shim, Diky Diningrat, Josh Herr, Chelsea Kyler, John Carlson,

Bhargavi Panchangam

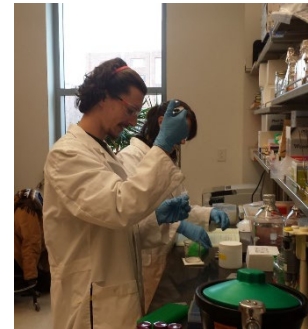
The Schatz Undergraduate Research Award in Tree Genetics:

The Schatz Awards for Undergraduate Research continue to provide unique opportunities for students to conduct research in the Schatz Center. In this past two years, four undergraduate students from the Forest Biology, Horticulture, Agricultural and Biological Engineering, and Military Science conducted research in the Schatz Center on a range of projects. Of special note

is that three of the Schatz Scholars applied for and received undergraduate research grants to bolster their projects. Forest Biology student Chelsea Kyler received an undergraduate research grant to further her research on genetic diversity in green ash in the 2013-14 school year, with Schatz Post-doctoral Scholar Teodora Best. That project is being completed in 2014-15 by Forest Biology student Jeffrey Osborne. Their work suggests that there were two major populations or sub-species of green ash in North America that have mixed extensively since the last ice age. Two Horticulture students currently in The Schatz Center have both recently received undergraduate research grants from The College of Agricultural Sciences as well. Alex Stanish's projects is to DNA markers from our gene sequence database for genetic analysis in red and white alder. This project is of interest to hardwood companies in the Northwest. Byron Bredael's project is construction of a genetic linkage map for green ash with which to locate the genes responsible for resistance or susceptibility to the Emerald Ash Borer insect.

Recent recipients of Schatz Awards for Undergraduate Research are:

- Alex Stanish, Horticulture, 2014
- Byron Bredael, Horticulture, 2014
- Jeffrey Osborne, Forest Biology, 2014-2015
- Chelsea Kyler, Forest Biology, 2013-2014
- Tyler Wakefield, Forest Biology, 2013
- Alex Berwager, Agricultural and Biological Engineering, 2013
- Matthew Kennedy, Military Science, 2013



Schatz Post-Doctoral Fellowship in Tree Genetics:

Recent recipient(s) of the Schatz Post-Doctoral Fellowship were Dr. Dongwhan Shim from South Korea (Ph.D. from Pohang University of Science and Technology), from 2011 – 2014, and currently Dr. Teodora Orendovici Best (Ph.D. from Pennsylvania State University) this year. Dr. Shim studied how gene expression from poplar and other hardwood trees

Schatz Center Faculty Travel Fund:

The Louis and Merry Schatz Faculty Travel Fund supported travel over the past two years by the Dr. Carlson and Dr. Teo Best to attend several meetings of interest to the Schatz Center. Attending scientific meetings is an important outreach component of the Schatz Center. This permits us to both inform the research community about the projects underway in the Schatz Center, and to learn the latest research results and approaches from other plant molecular genetics groups. Travel supported also included field trips to obtain research samples. The following travel was supported by the Schatz Travel Fund:

1) Fiscal year July 1, 2013 to June 30, 2014:

- Teo Best - July 15, 2013 to Roanoke, VA to pick up Honey Locust Trees
- John Carlson - July 20 - 30, 2013 to Forest Genetics Conference, Whistler, BC
- John Carlson - August 14 - 16, 2013 to Mid-Atlantic Plant Molecular Biology Symposium, Beltsville, MD
- John Carlson - Sept. 12 - 15, 2013 to NSF Hardwood Genomics Project Annual Meeting Columbia, MO
- John Carlson - Registration fee for the International Plant Genome Conference

2) **Fiscal year July 1, 2014 - June 30, 2015:**

- Teo Best - June 8 - 12, 2014 to 9th Annual Air Pollution Global Change Symposium Pacific Grove, CA
- John Carlson - July 20 - 23, 2014 to International Poplar Research Symposium, University of British Columbia for
- John Carlson - May 17 - 24, 2014 to International Plant and Animal Genome Asia Conference, Singapore.

MONT ALTO

Dr. Beth Brantley continues to lead very effective Schatz Center programs at Penn State's Mont Alto campus. Dr. Brantley hosted a very successful Schatz Tree Genetics Colloquium at Mont Alto in August of 2013 which focused on regeneration and genetics of oak species. The colloquium attracted over 50 attendees from state agencies, universities, and practicing foresters. The 2015 Schatz Colloquium will be held at the conference center on Penn State's main campus and will focus on the chestnut genome and integrating genomics into The American Chestnut breeding program. Talks will cover all of the major chestnut research programs around the world.

Dr. Brantley supervised 2 Mont Alto undergraduate student research projects during the past year, and organized our excellent biennial visit with Gordon and Karen Schatz in June, 2014, with 3 of our undergraduate student researchers. We are always grateful for this opportunity and the time that Gordon and Karen Schatz take to inform the students about the beautiful forests in Northern California, and research in The L.W. Schatz Demonstration Tree Farm at Humboldt State University. A separate report on the field trip has been prepared by the students.



SCHATZ CENTER RESEARCH UPDATE

The Schatz Center was awarded funding for several major research projects focused on the use of genomics for the discovery of genes to address forest health issues such as the chestnut blight, beech bark disease, the emerald ash borer, and the effects of environmental stresses such as ozone pollution, cold, heat, drought, and insect herbivory on species hardwood tree species. The species that we worked with in 2014 included Northern red oak, white oak, black cherry, American chestnut, Chinese chestnut, American beech, green ash, honey locust, tulip poplar, sweet gum, black gum, and sugar maple. The Schatz Center is also conducting research on the role of soil microbial communities in promoting growth and stress resistance in forest trees and such short rotation tree crops as hybrid poplars and willows. These research projects have been featured at the Schatz Center's website (<http://ecosystems.psu.edu/research/centers/schatz>), The Hardwood Genome Resources Project (www.hardwoodgenomics.org/), The Chestnut Genome Project (www.hardwoodgenomics.org/chinese-chestnut-genome), and the NEWBio Project (<http://www.newbio.psu.edu/>). The strong foundation provided by The Schatz Center has made it possible to successfully compete for external grant support for these projects from the National Science Foundation, the USDA's National Institute of Food and Agriculture, and the Forest Health Initiative. See our list of publications below for examples of results from our research.

Over the past year Dr. Carlson has been invited to give lectures about research in The Schatz Center at such venues as the Plant & Animal Genome Conference, the University of Maryland's Appalachian Ecology Lab, at POSTECH University in Pohang, Korea, at Seoul National University in Korea, at Greenwood Resources company in Westport, Oregon, and to the Materials Research Institute at Penn State.

Members of The Schatz Center published 3 book chapters and 13 papers in leading peer-reviewed scientific journals, in 2013 and 2014:

Peer-reviewed journal publications:

1. Jang H-Y, Rhee J-Y, Carlson JE, Ahn S-J. 2014. The Camelina aquaporin CsPIP2;1 is regulated by phosphorylation at Ser273, but not at Ser277, of the C-terminus and is involved in salt- and drought-stress responses . Accepted by Journal of Plant Physiology, 171(15): 1401-1412.
2. Chen CC, Bates R, Carlson J. 2014. Effect of environmental and cultural conditions in medium pH and plant growth performance of Douglas-fir (*Pseudotsuga menziesii*) shoot culture F1000Research 2014, 3:298.
3. Scully E; Geib SM; Carlson JE; Tien M; Hoover K. 2014. Metatranscriptome Analysis and Community Profiling of Microbes Associated with a Xylophagous Beetle Midgut: Insights into Nutritional Ecology. BMC Genomics, 15:1096, 21 pages.
4. Meinhardt LW, Thomazella DPT, Teixeira PJPL, Costa GGL, Carazzolle MF, Schuster SC, Carlson JE, Guiltinan MJ, Mieczkowski P, Farmer A, Ramaraj T, Crozier J, Davis RE, Shao J, Melnick RL, Pereira GAG, Bailey BA. 2014. Genome and secretome analysis of the hemibiotrophic fungal pathogen, *Moniliophthora roreri*, which causes frosty pod rot disease of cacao: Mechanisms of the biotrophic and necrotrophic phases. BMC Genomics, 15(1): 164, 25 pages.
5. Sha T, Liang H, Yan D, Zhao Y, Han X, Carlson JE, Xia X, Yin W. 2013. *Populus euphratica*: the transcriptomic response to drought stress. Plant Molecular Biology 83(6): 539-557.

6. Owusu SA, Staton M, Jennings TN, Schlarbaum S, Coggeshall MV, Romero-Severson J, Carlson JE, Gailing O. 2013. Development of Genomic Microsatellites in *Gleditsia triacanthos* (Fabaceae) Using Illumina Sequencing. *Applications in Plant Sciences*, 1(12): 1300050 , 4 pp.
7. Scully ED, Hoover K, Carlson JE, Tien M, Geib SM. 2013. Midgut transcriptome profiling of *Anoplophora glabripennis*, a lignocellulose degrading cerambycid beetle. *BMC Genomics*, 14:850, 26 pages.
8. Xu Y, Chen C-F, Thomas TP, Azadi P, Diehl B, Tsai C-J, Brown N, Carlson JE, Tien M, Liang H. 2013. Wood chemistry analysis and expression profiling of a poplar clone expressing a tyrosine-rich peptide. *Plant Cell Reports*, 32 (12), 1827-1841.
9. Scully ED, Geib SM, Hoover K, Tien M, Tringe SG, Barry KW, Glavina del Rio T, Chovitia M, Herr JR, Carlson JE. 2013. Metagenomic Profiling Reveals Lignocellulose Degrading System in a Microbial Community Associated with a Wood-Feeding Beetle. *PLoS ONE* 8(9): e73827, 22 pages.
10. Jang H-Y, Yang SW, Carlson JE , Ku Y-G, Ahn S-J. 2013. Two aquaporins of *Jatropha* are regulated differentially during drought stress and subsequent recovery. *Journal of Plant Physiology* 170(11): 1028-1038.
11. Kim H-S, Oh J-M, Luan S, Carlson JE, Ahn S-J. 2013. Cold stress causes rapid but differential changes in properties of plasma membrane H⁺-ATPase of camelina and rapeseed. *Journal of Plant Physiology* 170(9): 828–837.
12. Fang GC, Blackmon BP, Staton ME, Nelson CD, Kubisiak TL, Olukolu BA, Henry D, Zhebentyayeva Y, Saski CA, Cheng CH, Monsanto M, Ficklin S, Atkins M, Georgi LL, Barakat A, Wheeler N, Carlson JE, Sederoff R, Abbott AG. 2013. A physical map of the Chinese chestnut (*Castanea mollissima*) genome and its integration with the genetic map. *Tree Genetics & Genomes*, 9(2): 525-537.
13. Petit RJ, Carlson J, Curtu AL, Loustau ML, Plomion C, González-Rodríguez A, Sork V, Ducouso A. 2013. Fagaceae trees as models to integrate ecology, evolution and genomics. *New Phytologist*, 197: 369 – 371.

Chapters:

1. Nelson, C.D., W.A. Powell, S.A. Merkle, J.E. Carlson, F.V. Hebard, N. Islam-Faridi, M.E. Staton, L. Georgi. 2014. Biotechnology of Trees: Chestnut. In: Ramawat K, Merillon JM, Ahuja MR (eds), *Tree Biotechnology*, Chapter 1. CRC Press, Boca Raton, Florida, USA, April 1, 2014, pp. 3-35, ISBN 9781466597143.
2. Herr JR and JE Carlson. Traditional Breeding, Genomics-Assisted Breeding, and Biotechnological Modification of Forest Trees and Short Rotation Woody Crops. 2013. In: Jacobson M, Ciolkosz D (eds), *Wood-Based Energy in the Northern Forests*. New York: Springer, pp 79-99. ISBN: 978-1-4614-9477-5 (Print) 978-1-4614-9478-2 (Online).
3. Nelson, C.D., Powell, W.A., Maynard, C.A., Baier, K.M., Newhouse, A., Merkle, S.A., Nairn, C.J., Kong, L., Carlson, J.E., Addo-Quaye, C., Staton, M.E., Hebard, F.V., Georgi, L.L., Abbott, A.G., Olukolu, B.A. and Zhebentyayeva, T. 2014. The forest health initiative, American chestnut (*Castanea dentate*) as a model for forest tree restoration: